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Building life-cycle impact reduction

Possible 5 points

Intent

To encourage adaptive reuse and optimize the environmental performance of products and materials.

Requirements

Demonstrate reduced environmental effects during initial project decision-making by reusing existing building resources or demonstrating a reduction in materials use through life-cycle assessment. Achieve one of the following options.

Option 1. historic building reuse (5 points)

Maintain the existing building structure, envelope, and interior nonstructural elements of a historic building or contributing building in a historic district. To qualify, the building or historic district must be listed or eligible for listing in the local, state, or national register of historic places. Do not demolish any part of a historic building or contributing building in a historic district unless it is deemed structurally unsound or hazardous. For buildings listed locally, approval of any demolition must be granted by the local historic preservation review board. For buildings listed in a state register or the U.S. National Register of Historic Places (or local equivalent for projects outside the U.S.), approval must appear in a programmatic agreement with the state historic preservation office or National Park Service (or local equivalent for projects outside the U.S.).

Any alteration (preservation, restoration, or rehabilitation) of a historic building or a contributing building in a historic district on the project site must be done in accordance with local or national standards for rehabilitation, whichever are applicable. If building is not subject to historic review, include on the project team a preservation professional who meets U.S. federal qualifications for historic architects (or local equivalent for projects outside the U.S.); the preservation professional must confirm conformance to the Secretary of Interior's Standards for the Treatment of Historic Properties (or local equivalent for projects outside the U.S.).

OR

Option 2. renovation of abandoned or blighted building (5 points)

Maintain at least 50%, by surface area, of the existing building structure, enclosure, and interior structural elements for buildings that meet local criteria of abandoned or are considered blight. The building must be renovated to a state of productive occupancy. Up to 25% of the building surface area may be excluded from credit calculation because of deterioration or damage.

OR

Option 3. building and material reuse (2–4 points)

Reuse or salvage building materials from off site or on site as a percentage of the surface area, as listed in Table 1. Include structural elements (e.g., floors, roof decking), enclosure materials (e.g., skin, framing), and permanently installed interior elements (e.g., walls, doors, floor coverings, ceiling systems). Exclude from the calculation window assemblies and any hazardous materials that are remediated as a part of the project.

Materials contributing toward this credit may not contribute toward MR Credit Building Product Disclosure and Optimization - Sourcing of Raw Materials.

Table 1. Points for reuse of building materials

Percentage of completed project surface area reused	Points BD&C	Points BD&C (Core and Shell)
25%	2	2
50%	3	3
75%	4	5

OR

Option 4. whole-building life-cycle assessment (3 points)

For new construction (buildings or portions of buildings), conduct a life-cycle assessment of the project's structure and enclosure that demonstrates a minimum of 10% reduction, compared with a baseline building, in at least three of the six impact categories listed below, one of which must be global warming potential. No impact category assessed as part of the life-cycle assessment may increase by more than 5% compared with the baseline building.

The baseline and proposed buildings must be of comparable size, function, orientation, and operating energy performance as defined in EA Prerequisite Minimum Energy Performance. The service life of the baseline and proposed buildings must be the same and at least 60 years to fully account for maintenance and replacement. Use the same life-cycle assessment software tools and data sets to evaluate both the baseline building and the proposed building, and report all listed impact categories. Data sets must be compliant with ISO 14044.

Select at least three of the following impact categories for reduction:

- global warming potential (greenhouse gases), in CO_2e;
- depletion of the stratospheric ozone layer, in kg CFC-11;
- acidification of land and water sources, in moles H^+ or kg SO_2;
- eutrophication, in kg nitrogen or kg phosphate;
- formation of tropospheric ozone, in kg NO_x, kg O_3, or kg ethene; and
- depletion of nonrenewable energy resources, in MJ.

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Building life-cycle impact reduction

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Behind the Intent

Over their lifetimes, buildings have local, regional, and global environmental effects. Some occur during the harvest, extraction, manufacture, and transportation of materials; others involve construction and operations; still others take place at demolition and disposal. A life-cycle assessment (LCA) examines as many of these environmental effects as possible. This credit identifies several strategies for reducing harm done to the environment over a building's entire life cycle: restoring existing buildings, reusing building components, and reducing a building's environmental footprint through LCA.

Restoring existing buildings, preserving historic structures, and rehabilitating blighted buildings reduce the energy use and waste associated with demolition and construction A report by the National Trust for Historic Preservation, titled The Greenest Building: Quantifying the Environmental Value of Building Reuse, found that building reuse almost always offers environmental savings over demolition and new construction. A new, energy-efficient building will not compensate for the climate change effects of its construction for at best 10 years and perhaps 80 years[1]. Restoring existing buildings preserves a site's historical, cultural, and aesthetic values, and reusing or repurposing wood, brick, steel, stone, or other materials from off site can be a cost-effective and sustainable strategy.

For new construction projects, a cradle-to-grave LCA enables building professionals to understand the cumulative energy use and other environmental consequences resulting from all phases of the building's life. A comprehensive, quantitative analysis helps determine which materials best fit the project's needs throughout the building's lifetime. Employed as a design tool, LCA may reduce the amount of materials used ("dematerialization"), which can in turn reduce environmental harms and save money. An LCA also allows the design team to understand the trade-offs of material selection and energy performance and find an appropriate balance between the two. For example, high thermal mass can reduce a building's peak energy demands; an LCA can quantify the environmental damage associated with the additional materials used so that the team can compare those effects with the benefits for energy performance and then make more informed design decisions. By looking at how materials interact within the whole structure and enclosure rather than merely individually, it is possible gain a larger perspective and reduce overall environmental effects over the long term.

The whole-building LCA option takes into account a wide range of such effects. These include global warming potential, stratospheric ozone depletion, acidification of land and water sources, eutrophication, formation of tropospheric ozone, and depletion of nonrenewable energy sources. Those are only some of the most common, measurable, and well-understood environmental impacts that LCA tools evaluate. Current LCA tools cannot accurately measure human health, ecological, and land-use issues; however,

those effects are also important to a life-cycle approach to materials and are addressed under other Materials and Resources credits.

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[1] preservationnation.org/information-center/sustainable-communities/green-lab/lca/The_Greenest_Building_lowres.pdf (accessed May 28, 2013).

Our "watch" feature allows you to stay current on all aspects of this specific credit. In your account, you can control what you get updated on and how you receive your notifications. Hide

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Building life-cycle impact reduction

Possible 5 points

Required documentation

Documentation	Option 1	Option 2	Option 3	Option 4
Documentation of historic designation status	x			
Narrative describing demolition (if any)	x			
Documentation of how additions and alterations (if any) meet local review board requirements	x			
Narrative describing abandoned or blighted status		x		
Reused elements table and calculations		x	x	
Description of LCA assumptions, scope, and analysis process for baseline building and proposed building				x
Life-cycle impact assessment summary showing outputs of proposed building with percentage change from baseline building for all impact indicators.				x

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Building life-cycle impact reduction

Possible 5 points

Creating the Baseline Building

1. Identify the baseline building early in the design process, when the basic project scope has been determined, create the baseline building with which the team will compare design alternatives.
   Define the wall, roof, and floor assemblies following the performance requirements of the building envelope as defined in ASHRAE 90.1–2010, Appendix G, Opaque Assemblies, Vertical Fenestration, Skylights, and Roof Solar Reflectance and Thermal Emittance sections, for the project's climate zone. (For projects outside the U.S., see *Further Explanation, International Tips*.)
   For this credit, the total area of exterior walls, floors and roofs may differ between the baseline building and the proposed building to account for differing proportions or geometry.
2. Customize the baseline building for the project to create the proposed building. Modify the initial baseline building design to reduce the environmental effects while meeting the specific needs of the project, but keep the following parameters the same so that the baseline and proposed models can be accurately compared:

   LCA scope requirements. The functional unit and system boundary must be identical for the baseline and proposed buildings.

   Size. The gross floor area of the baseline and proposed buildings must be the same. The two designs can have different massing, provided the gross area is the same.

   Function. The baseline and proposed buildings must serve the same programmatic function. If the project is a mixed-use residential building with retail in the first floor, the baseline building must have the same program, but the elements can be in different locations in the building. If the project is a hospital with stringent air quality and humidity control, both the baseline and the proposed cases must meet those functional requirements.

   Orientation. The orientation—the directional exposure—of the baseline and proposed buildings must be the same, but the shape may differ. Orientation must be the same because exposure to the sun affects solar heat gain within the building and will skew LCA results for energy performance.

   Location. Both the baseline and the proposed buildings must be located in the same ASHRAE 90.1–2010 climate zone and assumed to be on the same site.

   Operating energy performance. The baseline and proposed buildings must meet EA Prerequisite Minimum Energy Performance by adhering to the requirements of ASHRAE 90.1–2010, Appendix G, Opaque Assemblies, Vertical Fenestration, Skylights, and Roof Solar Reflectance and Thermal Emittance sections, because comparing an energy-efficient proposed building with an underperforming baseline building will skew the results. Increasing wall mass or insulation unnecessarily in the baseline building to show dematerialization in the proposed building is not acceptable. Energy modeling for either building is not required for this credit.

Other portions of the baseline building may be modified from the basic ASHRAE 90.1 requirements to capture the LCA goals of the project team.

3. Input the baseline building into the chosen tool. Once the baseline building is complete, input the design into the selected tool to estimate the benchmark environmental impacts. Save the baseline building model as a separate LCA project so that the results will be available for comparison with the proposed building and for submission to USGBC.

   As the design process proceeds, the baseline building can be modified, modeled, and saved as new LCA versions so that the team can compare the embodied impacts of design alternatives. While iterations of the LCA model may occur during construction, it is not expected that the documentation for the credit be updated after it has been submitted to USGBC.

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Building life-cycle impact reduction

Possible 5 points

LCA Tools

Selection

This credit does not require design professionals to become LCA experts, but the choice of tool can determine whether an LCA specialist is required. Every LCA tool is populated with background data sets that form the basis of the assessment. Some LCA data are specific to the location of the building construction or the location of product manufacture because of the region's electric grid, for example. Different types of tools require varying levels of data set manipulation. There are two types of tools to consider.

Design team LCA tools simplify and streamline the LCA process for non-LCA practitioners. They manage the data and calculations in the background and do not allow the user to add or customize data. The user inputs material selections consistent with the building design and can then explore the environmental effects of design modifications by changing materials, floor area, or other aspects of the building.
Design team LCA tools have calculation factors specific to the country or region for which they were designed. Examples include the following:

- North America: ATHENA® Impact Estimator, athenasmi.org/our-software-data/impact-estimator/. This tool can import a bill of materials from a CAD system.
- United Kingdom: Envest 2, envest2.bre.co.uk/
- Australia: LCADesign. This tool can import a bill of materials from a CAD system.

LCA practitioner tools require the user to select the appropriate data sets and calculation factors. They typically conduct LCAs on a product-by-product basis and may require different methodological decisions for the products being examined. The practitioner then aggregates the results to the whole building level. Examples include the following:

- SimaPro, simapro.co.uk/
- GaBi, gabi-software.com/america/index/

Project teams that choose LCA practitioner tools will likely need to bring in an LCA specialist.

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Life Cycle

Building life-cycle impact reduction

Possible 5 points

Impact Measures or Indicators

The impacts measured in LCA are divided into two categories, as described in ISO 21930–2007, which deals with EPDs for building products. Impacts are either expressed in terms of the categories of life-cycle impact assessments (LCIA) or derived from a life-cycle inventory (LCI) and not assigned to impact categories.

LCIA is an additional step in analysis that interprets and quantifies the resulting ecological effects of resources used and waste emitted over the life-cycle of the product. In contrast, LCI simply quantifies flows in and out of the process in terms of resources used and depleted and waste created.

The first five measures specified in the credit requirements are impact categories of LCIA; they are the only LCIA categories cited in ISO 21930. Other LCIA measures are in use or being developed (e.g., human health and ecotoxicity measures) but are less quantifiable than the measures required for LEED, although they may be reported separately. Other impact assessment methods not listed in Table 4 may be used if the reasons are justified and documented.

The sixth measure in the list, depletion of nonrenewable energy resources, is in the second category because it is derived directly from the LCI (defined in the ISO standard as "phase of life-cycle assessment involving the compilation and quantification of inputs and outputs for a product throughout its life-cycle").

Several other LCI aggregations are cited in ISO 21930 (e.g., depletion of nonrenewable material resources, use of renewable materials, and consumption of freshwater). These additional measures have not been included in the credit for the sake of simplicity. Teams may take these indicators into account in the LCA but are not required to submit them to meet the credit requirements.

For all the measures listed in Table 4 except depletion of nonrenewable energy resources, the software tool categorizes emissions and then applies characterization factors to create equivalence measures in the units shown in the table.

- In design team LCA tools, the characterization factors for the country or region are automatically generated.
- In LCA practitioner tools, the user must select the characterization factors and corresponding units for the country or region.

North American projects typically use the U.S. Environmental Protection Agency's TRACI (Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts) system. Projects in other parts of the world use the CML (Institute of Environmental Sciences) or ReCiPe system.

The impact assessment method must be no older than the most current version available on the LEED project registration date:

- TRACI, version 2.1 or newer
- CML, version 2001–November 2012 or newer
- ReCiPe, version 1.07 (midpoints) or newer

If these versions are not available in the chosen LCA tool, the project team must explain and justify the use of an alternative. Other impact assessment methods are available. If the chosen LCA tool offers options, the project team should weigh their pros and cons and choose the most appropriate method.

The same assessment method must be used for the baseline and proposed buildings.

For the purposes of complying with this credit, depletion means "the amount used," as opposed to more complex measures involving calculation of the amount used relative to existing physical or economic reserves.

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International Tips

Option 1. Historic Building Reuse

Projects outside the U.S should consult the historic preservation guidelines set forth in the local or national registry of historic places. Many countries have established their own process for determining historic significance of a structure or building. If the project is in a country without a process for determining the historic status of a building, project teams are encouraged to consult the UNESCO website (whc.unesco.org/en/conventiontext) or the Venice Charter (icomos.org/charters/venice_e.pdf) to determine historical significance.

Option 4. Whole-Building Life-Cycle Assessment

For projects outside the U.S. pursuing this option, the baseline building is based on ASHRAE 90.1–2010. The purpose of this requirement is to provide a minimum set of guidelines regarding the performance of the structure and enclosure being studied in the LCA. Projects outside the U.S. are expected to develop a baseline building representing typical construction for their region meeting local applicable building performance requirements. Additional documentation may be needed to demonstrate how the baseline building meets the requirements of the credit.